

## 2. TEST APPROACH

**This section covers the SMGT test approach, and the planning, preparation and execution phases.**

### 2.1 APPROACH

The approach to defining and implementing tests in the O&GS Project Operations SM Test Program consists of four phases: planning, preparation, execution, and post-test reporting. Each phase is briefly discussed here and will be described in detail throughout the remainder of this document.

Planning consists of identifying the various tests that comprise the test program and developing this **Master** test plan which defines the test objectives, approaches, facility requirements, and personnel requirements for each test. Test definitions and schedules are presented in Appendices A through D of this document. These tests fall into four general categories: 1) ground system string tests, 2) flight hardware, 3) command plan ground tests, and 4) ground and space communication network testing. The first three categories will be included in the O&GS Project SMGT program and the fourth category of tests will be the communications tests which include IPAs, PDTs and ETES.

Preparation for each test will consist of developing detailed test specific plan/procedures and scheduling the facilities and personnel necessary to support the execution of the test. Any briefing messages required for testing will be completed during the preparation phase. The preparation phase will also include a dry run, as applicable and time permitting, to insure the successful completion of the actual test.

Execution of each test will consist of conducting a Test Readiness Review (TRR), an on-line pre-test brief, executing the detailed test plan/procedure, and conducting a post-test debrief. The detailed test plan/procedure will be annotated to reflect the as-

January 26, 1996

run procedure resulting from the execution of the test. This as-run procedure will be archived in the HST library after the test is complete.

Post-test reporting activities for each test will consist of analysis of test results and Test/Simulation Anomaly Reports (TSARs) written **during test execution** and **an** evaluation **to determine the** success or failure of the test, based on the **test** requirements matrix. After each test a flash test report will be generated. The flash test report **consists of** a cover sheet, a list of **any** TSARs written, and a copy of the requirements matrix indicating which requirements were met and which were not. The necessity to perform follow-up testing and the definition of these tests, based on the approach described here, will be determined based on these post-test activities. A final Test Report will be released **four** weeks after test completion.

## 2.2 PLANNING PHASE

This section contains the definition of the O&GS SM Project Operations Test Program; the objectives of the Program; the test approach; testing standards; generation of requirements, verification matrices; outline of the roles and responsibilities; and identification of the tests. **All these elements as defined in this document** comprise the O&GS SM Project Operations Test Program.

### 2.2.1 O&GS SM Project Operations Test Team

An O&GS SM Project Operations Test Team will be the focal point for all SM testing activities. This O&GS SM Project Operations Test Team will be formed to provide leadership, decision making authority, and direction during the implementation of the O&GS SM Project Operations Test Program. This O&GS SM Project Operations Test Team will be coordinated by the O&GS SMSE. The O&GS SM

January 26, 1996

Project Operations Test Team will consist of members from the following organizations:

- Code 441
- Code 442
- Code 500
- STScI
- MOSES Systems Engineering
- MOSES SVG
- Flight Operations **Support Team**
- ITAV
- PDB Office
- Instrument and **ORU** Contractors
- VEST
- DOC

The O&GS SM Project Operations Test Team will be formed early in the planning phase of the O&GS Project Operations SM Test Program. The responsibilities of the O&GS SM Project Operations Test Team will include:

- Establish**ing** and managing **the objectives and** priorities for all test activities.
- Coordinat**ing** all organizations supporting the O&GS SM Project Operations Test Program.
- Coordinat**ing** the production, distribution and review of documentation generated as a result of this testing.
- Coordinat**ing** test schedules and resources.
- Maintain**ing** requirements verification matrices
- Aid**ing** in problem resolution
- Establish**ing** plan/procedure, and flash and final test report distribution.

January 26, 1996

### 2.2.2 Objectives of the O&GS SM Project Operations Test Program

The O&GS SM Project Operations Test Program test requirements matrix is in Appendix E. It will be used to generate the test objectives for each test.

The objectives of the O&GS Project Operations SM Test Program **Requirements which** are:

- Verify the ability of the SM Command plan to support SM operations.
- Verify the ability of the ground and flight systems to support SM operations, Servicing Mission Observatory Verification(SMOV) and post SMOV activities.
- Verify compatibility of the ground system with the flight H/W and software (S/W).
- Verify the ability of the ground system to support simulations and Joint Integrated Simulations (JISs).
- Verify the ability of the ground system to support flight hardware testing.
- Verify communications (command and telemetry capabilities) between KSC elements, JSC elements, Tracking and Data Relay Satellite (TDRS) System (TDRSS), STGT, DSN/GN and GSFC elements.
- Provide Level III verification of PDB servicing mission critical file parameters.

### 2.2.3 O&GS SM Project Operations Test Approach

The O&GS SM Project Operations Test approach will be the same approach that was used during the first servicing mission. There will be SMTGs (ground system string, ground system/flight system/hardware and command plan end-to-end tests) and communications tests (IPAs, PDTs and ETEs). These tests are detailed in the following four appendices:

January 26, 1996

- Appendix A details the ground system string tests
- Appendix B details the flight hardware SMGTs
- Appendix C details the command plan SMGT
- Appendix D details the communications tests.

Each appendix contains the definition of test objectives, identification of lead organization, identification of supporting organizations and resource (i.e., people, facilities, systems) and requirements. This test plan will cover all the separate tests that make up the O&GS Project Operations SM Test Program. Each individual test will have a unique test plan/procedures written and reviewed prior to the execution of the test. Sections 1 - 5 of each test plan/procedure will contain any test specific planning items required for that test. Section 6 of each test plan/procedure will contain the pre-test set-up, step-by-step procedures including applicable command plan sequences and the post-test hardware/ software wrap-up. At the conclusion of each test there is an on-line post-test briefing, a flash test report will be issued, and there will be a final test report issued that covers the test results.

2.2.3.1 Servicing Mission Ground Test. There are three types of SMGTs, ground system string tests, integrated ground system/flight system/flight hardware and command plan tests. The ground system string tests will be used to validate the ground system readiness to support flight hardware testing. System Readiness (SR) #2 , #3 ,and #4 requirements will be satisfied by the ground system string tests. There are three SMGT ground system string tests, SMGT 21, 22, and 23 part 1. These SMGTs are detailed in Appendix A. The second type of SMGT is the integrated ground system/flight system/flight hardware tests. **The H/W tests will be executed after the appropriate ground string test which support the corresponding capabilities have been completed.** These SMGTs will verify that the ground system can interface with the flight hardware and can successfully execute the command plan. There will be a flight hardware test run for each ORU/ORI that is

January 26, 1996

installed as part of SM. Currently, there are **eleven** hardware SMGTs: SMGT 24, 25, 26, 27, **29, 30, 31, 32, 34, 35, and 36**. The hardware SMGTs are detailed in Appendix B. The command plan will also be validated during this phase of testing. The command plan SMGT is SMGT 23 part 2 and is detailed in Appendix C. This will be the last SMGT run before the **SM**.

2.2.3.2 Interface Performance Activities. The IPAs test the interfaces between JSC and GSFC. These tests are run prior to the JISSs. There are seven IPAs scheduled to support the SM. The first two are early JSC telemetry and hazardous command tests. The first two IPAs will be rerun after the ground system is ready for **Servicing Mission (SM)** external testing, followed by three additional IPAs, integrated load checkout, external facility support, and Electrical System Test Laboratory/ Shuttle Avionics Interface Laboratory (ESTL/SAIL) testing.

2.2.3.3 Performance Demonstration Test. The PDTs test the interfaces between KSC and GSFC. There are 5 PDTs: aft deck telemetry and command testing, **Cargo Interrogation Test Equipment (CITE)** interface testing, Merritt Island Annex (MILA)/GSFC Ground Support Equipment (GSE) testing, Orbiter Processing Facility (OPF) interface testing, and the pad interface testing.

2.2.3.4 End-to-End. The ETEs are tests of multiple systems to verify communications links and configurations prior to launch. There are four ETEs, CITE ETE testing, **Pad** ETE testing, ESTL/SAIL ETE testing, and Mission Readiness Testing (MRT).

#### 2.2.4 Definition of Test Standards

Test standards include documentation standards, review standards, and anomaly reporting requirements. The documentation standards are the documents required for each test, the format, content, and

January 26, 1996

distribution of these documents. The review standards state which organizations will review the required documents, the review time frame, and the incorporation of comments into the documents. The documentation and review standards are described in section 3. The anomaly reporting requirements for the O&GS SM Project Operations Test Program are described in section 4.

#### 2.2.5 Generation of Requirements Verification Matrices

**A** requirements verification matrix for the O&GS Project Operations SM Test Program **is** contained in appendix E of this **document**. This matrix maps the O&GS **SM requirements** to the individual tests that will verify them. These requirements will be the success criteria for the systems implementation and will be used to determine if the test was successful in demonstrating the requirements.

#### 2.2.6 Generation of this Document

This document will be used as the O&GS SM Project Operations Test Program guidelines. This document will define components such as deliverables, content, **and** reviews. **In addition the plan** outlines the formation of the O&GS SM Project Operations Test Team. This document will be reviewed by the O&GS SMSE, SMOM, ITAV, SVG and all supporting organizations for content and format. The final document will be used as a guideline for all testing.

### 2.2.7 Roles and Responsibilities

The O&GS SMSE has the overall responsibility for the O&GS Project Operations SM Test Program. The O&GS SMSE reports to the HST Project Verification team. The O&GS SMSE has the responsibility for overseeing the SMGT and communication test effort. MOSES SVG and ITAV are responsible for coordinating the preparation, execution, and reporting the O&GS Project Operations SM Test Program. Support from the organizations in figure 1-1 will be required in the preparation and execution of these tests. Roles and responsibilities for each specific test **are defined** in the appropriate appendix.

### 2.3 Preparation Phase

The Preparation Phase consists of detailed planning activities and the development of the step-by-step procedures for a test. These activities focus on specific tests defined during the Planning Phase and begin one to three months prior to the planned execution of the test and conclude with the TRR. The O&GS SM Project Operations Test Team formed during the planning phase will continue to coordinate the preparation phase activities.

The activities to be performed during this planning phase are:

- Definition of test flow and major test activities.
- Generate sections 1 - 5 of Test Plan/Procedure (as described in section 3) one to three months prior to planned execution of the test.
- Generate the test specific O&GS SM Project Operations Test Program requirements verification matrix.
- Generate a PDB certification matrix that contains all commands to be sent during the test, with their level of certification.



January 26, 1996

- Develop Section 6 of the Test Plan/Procedure (step-by-step procedures).
- Define success criteria.
- Specify detailed resource (i.e., people, facilities, systems) requirements.
- Specify step-by-step activities associated with pre-test, test, and post-test activities.
- Produce and electronically distribute as-planned Test Plan/Procedure 3 days prior to the test execution date.
- Generation of briefing messages 3 days prior to test.
- Schedule and conduct TRR 1 to 3 days prior to test.

#### 2.3.1 Roles and Responsibilities

The roles and responsibilities of various individuals and supporting organizations in the preparation phase of the testing are:

- O&GS SMSE coordinates all activities associated with preparation phase activities.
- Lead organizations as Test Coordinators coordinate all activities associated with a specific test.
- O&GS SM Project Operations Test Team coordinates resource planning activities to insure all resources are available to support execution of the test.
- All other organizations provide the support required.

#### 2.3.2 Preparation Phase Products

The products to be produced during this phase of testing are the test procedure to be used for the test run, briefing message, and TRR package.

## 2.4 EXECUTION PHASE

The Execution Phase consists of the execution of **the** step-by-step test procedure in Section 6 of the Plan/Procedure generated during the Preparation Phase. These activities focus on specific tests, beginning after the successful completion of the TRR and ending with the post-test debriefing.

The activities which are defined within the Execution Phase include an on-line pre-test briefing, test execution, anomaly reporting, maintenance of as-run procedures, and post-test debriefing. Each of these activities is defined in the subsequent paragraphs.

A pre-test **set-up** briefing will be held for each test session over voice circuits. The briefing will occur at least 30 minutes prior to the start of initial set-up and include a review of any **test set-up** redlines which were made to the test plan/procedure during the TRR. **A Test pre-brief will occur on the communications loop after the test set-up and prior to execution of the test plan/procedure which will include a review of all redlines which were made to the test plan/procedure during the TRR.** The primary purpose of the pre-test **set-up** briefing and **Test pre-brief** is to verify that all test participants have a copy of the test plan/procedure, are aware of any deviations to the test script, that all systems are operational and running nominally, and that all voice and data circuits are configured correctly.

Once the pre-test briefing has been completed, the actual execution of the step-by-step test plan/procedures will begin. The Test Director will signal the start of test execution, at which time the Test Conductor will begin following the test procedures. The Test Conductor will verify system checklists and requirements as they are met during the test. The Test Coordinator will be responsible for checking off requirements as

January 26, 1996

they are being verified during test execution. Any deviations to the test plan/procedure must be approved by the Test Director prior to being implemented. Any such deviations must be documented and announced to all participating elements during the test. The Test Conductor will be responsible for maintaining a master copy of the as-run test procedure. The test plan/procedure must be electronically updated by the Test Coordinator before it is filed with the HST library. This will insure that the as-run procedure is kept on file.

All anomalies observed during execution of the test will be documented by the Test Coordinator, using the TSAR form. It will be the responsibility of the Test Director to track all documented anomalies to insure closure or resolution.

At the conclusion of test activities, a post-test debrief will be held. This debrief will be conducted with all participating elements on the voice communications loops immediately following test completion. The Test Director will lead the debrief discussion with participation from all test support elements. Each element will identify any anomalies or problems observed during testing. The Test Coordinator will record these anomalies for inclusion in the flash test report. Once all elements have reported the as-run findings, the Test Director will announce the schedule for all post-test activities including completion of analysis, date of formal test debrief, and delivery date for the flash test report and the final report.

Post-processing of data collected during a test will also be included in this phase. Post processing activities include investigation of any test anomalies that occurred during test execution. The requirements matrix will be reviewed by the Test Coordinator to prepare it for publication in the flash test report. Any requirements that could not immediately be verified during test execution will be noted in the flash test report and verified during the post-processing activities.

Products collected at the conclusion of the test are the as-run test plan/procedure, any TSARs written, appropriate printouts from all systems, and any system tapes and/or disks which were produced. The Test Coordinator will be responsible for keeping these items.

## 2.5 REPORTING PHASE

The Reporting Phase consists of two parts; the flash report and the final report. Each SMGT will produce these two reports. A flash report is a short two or three page report that consists of a cover sheet that summarizes the test results, and states if the test needs to be rerun, if it was successful, or partially successful. **A** lists the TSARs written during the test **execution** and a copy of the completed requirements matrix **are also included**. The flash report is issued within three days of test completion. The final test report will be issued within 4 weeks of test completion, and will contain the results of the anomaly investigations that were conducted **on each** TSARs written during the test. The requirements matrix as completed or updated as applicable and TSAR list will also be included in the final report.

The Test Coordinator will be responsible for checking all requirements to ensure that any requirements that were not successfully verified are indicated as such for the flash test report. The Test Coordinator will use all information compiled during and after test execution to complete the requirements verification matrix for the final test report.

The Test Coordinator, with input from all supporting test elements, will make any necessary recommendations for follow-up testing activities. This would include reprocessing data collected during the test, requesting additional analysis time, and informing the test community of a retest date, if necessary.